Journal of the Society of Arts.

FRIDAY, APRIL 4, 1862.

THE NATIONAL MEMORIAL TO THE PRINCE CONSORT.

The Council of the Society of Arts, taking a deep interest in the success of the proposal to erect the National Monument to the Memory of the Prince Consort, their lamented President, and considering that it is due to all the subjects of the Queen, that every individual amongst them, however humble, should have the opportunity of contributing his mite towards this object, have agreed to the following report:—

1. The subscriptions hitherto have been limited almost exclusively to those of the wealthy and mercantile classes, whilst a very small portion has been subscribed by the people generally. The Nobility and Gentry, the City Corporations, Banks, Mercantile Firms, Municipal Corporations, and the like, have been addressed by the Committee presided over by the Lord Mayor of the City of London. No steps, however, have been taken, nor does it appear that any are contemplated, to make known to each individual man and woman constituting the body of the people, and residing either in the Parishes and Hamlets of the United Kingdom or in the Colonies, the Memorial which it is proposed to erect, nor has any opportunity been hitherto afforded them of adding their contributions to the general fund. If this were done, all would affectionately unite with their Queen in raising a Monument to the memory of the Prince who neglected no opportunity to promote their welfare. It is only through very extended parochial and other agencies, that the necessary information can be generally given, and the Council has, therefore, determined forthwith to invite influential persons, representing all the great interests of the country, the Church of England, and other religious denominations, as well as the great employers of labour, to unite with them as a Committee to convey this information, and to make such arrangements as may afford to every one of her Majesty's subjects, throughout the United Kingdom and the Colonies, the opportunity of taking a part, however humble, in promoting the Memorial, by subscriptions however small.

The Queen, "following the movement of her people," has asked "to be allowed to take part with them in doing honour to her beloved Prince;" and the Council, believing that the women of England especially will rejoice to work in concert with their Queen, intend to invite Ladies to be Members of the proposed Committee.

2. Should more funds be realised than will be required to carry properly into effect the Monument "on a scale of sufficient grandeur," as stated in the communication made by the Queen's command to the Lord Mayor, it will be for Her Majesty, who has already pointed out the character of the intended Monument, to decide on the application of any surplus to some object of comprehensive utility which the Prince Consort had at heart.

By order of the Council,

P. LE NEVE FOSTER,

Secretary.

INTERNATIONAL EXHIBITION OF 1862.—SEASON TICKETS.

Members of the Society and others are informed that Season Tickets may be obtained at the Society's house, on application to Mr. S. T. Davenport, the financial officer. Price three guineas and five guineas, the latter also admitting to the Horticultural Gardens and *fetes* during the season.

INTERNATIONAL EXHIBITION OF 1862.—GUARANTEE.

The Council beg to announce that the Guarantee Deed is now lying at the Society's House for signature, and they will be much obliged if those gentlemen who have given in their names as Guarantors, as well as others interested in the Exhibition, will make it convenient to call there and attach their signatures to the Document. Signatures for sums amounting in the aggregate to £447,950, have been attached to the Deed.

EXAMINATIONS, 1862.

NOTICE TO LOCAL BOARDS.

The attention of Local Boards is particularly drawn to Par. 14 of the Examination Programme, as follows:—

14. The previous examinations must be held by the Local Boards sufficiently early in the year 1862 to allow the results to be communicated to the Council, on a form which will be furnished on application, on or before the 23rd April, *i.e.*, four weeks before the commencement of the final examinations.

Any Local Boards expecting to have Candidates desiring to be examined in music, should apply to the Secretary of the Society of Arts without delay, who will furnish them with a copy of a form of test to be used at the Previous Examinations, as mentioned in paragraph 112 of the programme.

WEEKLY PROGRESS OF THE INTERNATIONAL EXHIBITION.

The past week has witnessed the entire disappearance of the gigantic dome scaffolds; not a vestige of either now remains, and many a one who will gaze upon those clear vaults of glass will be puzzled to know how such lofty and vast structures were raised and put together in the short period of three months. Now that these great stages and net-work of climbing pillars have been removed from the building, the raised platforms under each dome are being vigourously pushed forward, and a few days will see them completed. It is intended to reserve seats on these platforms for those who are invited to attend and take part in the opening ceremonial.

The past week has been signalised by the insertion of Mr. Hartley's stained glass into the large circular window, in the tympan of the eastern entrance. This window is thirty feet in diameter; and viewed from any portion of the nave or galleries, is brilliant in its colouring. It is to form the disc of an immense clock-face, forty-five feet in diameter, to be furnished by Messrs. Dent and Co. The western window will be filled in a similar manner.

Scaffoldings are now erected against the walls in which these windows are set, and Mr. Crace's artist-hand will soon be busy in completing this portion of the decoration, which alone remains to be perfected to render the *coup-d'œil*, from end to end of the spacious and vaulted nave, not to be rivalled by the interior of any other building.

The little progress made in the fittings of the French court contrasts unfavourably with the immense strides made during the past week by the British exhibitors. The arrangement of their stalls and exhibiting cases is geometrical, and converging to a centre. In order to render the seclusion—which they have obtained by partitions—more complete, they have barricaded all the entrances to their portion of the building, while the words "On n'entre pas ici" sufficiently indicate their desire to be left to themselves.

Most backward of all in this race of nations are the Austrians, who, up to the present time, have only a single package to fill the space allotted to them.

All praise is due to the Belgians, whose courts are well advanced towards completion.

The eastern annexe has been completed, and a gang of painters is now employed in decorating the ribs. Stalls, galleries, and green-houses, are now rising in this portion of the building, as if by magic. Agricultural implements and steam-engines are taking up their positions, and many a case containing costly goods only waits to have its cover removed to display its treasures.

The scene in the western annexe is still one of bustle and confusion. The work, however, is progressing rapidly; and now that all the heavy foundations are in, no fear is entertained as to its speedy completion.

Through every door bales and cart loads of goods are arriving in incessant and unvarying succession, which is as interesting to watch for a day as it would be monotonous to gaze at for a week. Along the Cromwell and Prince Albert's roads, carts, drays, and waggons of all descriptions, from the greengrocer's cart up to Pickford's vans, drawn by teams of from two to fifteen horses, stand in line four and five deep.

Now and then some ponderous iron casting or huge machine is seen slowly rolling along, harnessed to Bray's traction engine, which, with thick and short pants, moves steadily to its destination. In front stands the steersman, who manages, with his revolving wheel, to a hair's breadth the movements of this street locomotive.

On the 1st instant there were no fewer than 201 waggons, carts, &c., waiting at the several doors of the building to be unloaded.

Inside the building the visitor is struck with the appearance of confusion, and every element of chaos heaped around; but a few minutes' attention shows that this apparent chaos is under control, and that, owing to the arrangement, zeal, and ability of the staff connected with every department, coupled with the energy of the exhibitors—each one doing his own work—the multifarious cases, packages, and boxes are falling into their places.

The number of packages received in one *day* during the past week amounted to 4,459, or only 300 less than the greatest number received during the busiest *week* which preceded the opening of the Exhibition of 1851.

Some slight idea may be gained of the duties discharged by the staff when it is stated that during the week ending on the 29th inst., there were 18,000 letters despatched and 8,000 received.

The 1st of May will see everything in order. The following is the outline of the ceremonial, so far as its general principles have been approved by the Queen and the various functionaries who will take part in it :—

Ceremonial to be observed at the State Opening of the International Exhibition.

The Queen, being most anxious to mark her interest in the success of an undertaking, in promoting which the Prince Consort had taken a most active part, has notified her wish that the opening of the Exhibition should bear as much as possible the character of a national ceremony. Her Majesty has, therefore, been pleased, under the present impossibility of herself performing that ceremony, to appoint his Royal Highness the Duke of Cambridge, K.G., his Grace the Archbishop of Canterbury, the Lord High Chancellor, the Earl of Derby, K.G., the Lord Chamberlain, and Viscount Palmerston, K.G., G.C.B., to be her representatives to conduct it in her name.

1. Her Majesty's Ministers and the Royal Commissioners for the Exhibition of 1851 will attend in the procession, and her Majesty's Commissioners for the Exhibition will invite the royal and distinguished persons at the head of the respective foreign commissions, and the foreign ambassadors and ministers accredited to this country, to take part in the ceremony.

II. Her Majesty's Commissioners will seek the co-operation of the Guarantors of the Exhibition, jurors, members of both Houses of Parliament, heads of the church, universities, law, army, navy, and volunteers, the municipalities, scientific and artistic institutions, the local and other committees aiding the Exhibition, &c., in giving to the state opening a national character. For such persons there will be a number of reserved seats, but the number is necessarily limited. Whilst desiring to meet the wishes of all, her Majesty's Commissioners must reserve to themselves full power of dealing with the arrangements according to their discretion. Her Majesty's Commissioners request that gentlemen occupying officially reserved seats will appear in uniform, official, or court dress.

III. The principal ceremonies will take place under the two domes and along the whole length of the nave. The official reception of her Majesty's representatives and of distinguished visitors taking part in the ceremonial, will be held in the central south court. The procession will start from this point and proceed to the west dome. Here will be a chair of state, and, after a verse of the National Anthem has been sung, an address will be received. The procession will then move down the nave to the east dome, where the musical performances will take place, after which the procession will return to the throne at the west dome; a prayer will be offered by the Bishop of London, and the Hallelujah chorus and the National Anthem will be sung. The opening of the Exhibition will be declared by his Royal Highness the Duke of Cambridge. Military bands will be stationed in the south central court.

By order of her Majesty's Commissioners.

F. R. SANDFORD, Secretary.

International Exhibition, 28th March, 1862.

The Japanese Embassy, which has already reached Marseilles on its way to Paris, intends to be in London in time to be present at the opening ceremonial.

The following circular has been addressed to the exhibitors of machinery.

Exhibition Building, South Kensington, W., April 2.

Sir,—I am directed by her Majesty's Commissioners to request that you will at once employ such a number of workpeople to put together your machinery in the Exhibition as will ensure the whole of your works being completed before the 20th of April.

After that date it will only be permitted to complete the arrangements for fencing off the machinery, and to get all in readiness for the opening of the Exhibition on the 1st of May.

Machinery in motion will be allowed to be tried between the 22nd and 25th of April, and the connection between the steam-engines used as prime movers, and the main steam and exhaust pipes in the western annexe must be absolutely finished by the 15th of April.

I am, Sir, your obedient servant,

F. R. SANDFORD, Secretary.

SIXTEENTH ORDINARY MEETING.

Wednesday, April 2nd, 1862.

The Sixteenth Ordinary Meeting of the One Hundred and Eighth Session was held on Wednesday, the 2nd instant, George F. Wilson, Esq., F.R.S., Treasurer of the Society, in the chair.

The following candidates were proposed for election as members of the Society :—

Bremner, Samuel	"Belle Sauvage" Printing Works, Ludgate-hill, E.C.
Cave, Stephen, M.P.	35, Wilton-place, S.W.
Cocksedge, Henry Barry	20, Bucklersbury, E.C.
Coxon, Benjamin Payne	Warrington.
Crispe, James	4, Cheapside, E.C.
Donaldson, J. Hunter	176, Oxford-street, W.
Harris, Samuel J.	176, Oxford-street, W.
Head, Samuel Heath	5, Martin's-lane, Cannon-st., E.C.
Potter, Thomas	44, South Molton-street, W.
Shrimpton, John	New Wanstead, N.E.
Spence, Peter	Manchester.

The following candidates were balloted for and duly elected members of the Society :—

Coles, Charles	86, Great Tower-st., E.C., and The Firs, Mitcham, S.
Dawson, Henry	16, Finsbury-pl. South, E.C.
Dovey, Wm. Thos.	10, Cunningham-place, St. John's-wood, N.W., and 6, Crosby-square, E.C.
Houghton, James	114 and 115, Tottenham-court-road, W.
Howe, Wm. Francis	6, Newman's-court, Cornhill, E.C., & 5, Lower Belgrave-street, Eaton-square, S.W.
Mackay, Thos. Miller	24, Leinster-gardens, Hyde-park, W.
Marshall, Joseph Gilbert Blair	7, Vicarage-terrace, Stratford, E.
Pearce, Wm. Peter	66, Gresham House, Old Broad-street, E.C.
Preedy, J. K.	98, Gracechurch-street, E.C.
Purdy, William	54, Old Broad-street, E.C.
Ward, Wm. George	Sherwood-rise, near Nottingham.
Wood, Henry Thos.	22, Watling-street, E.C.

The Paper read was—

ON THE INTRODUCTION AND USE OF ELASTIC GUMS AND ANALOGOUS SUBSTANCES.

By Frederick Walton.

The leading feature of the paper I shall now have the honour of reading to you, and the one to which I wish more particularly to direct your attention, is the invention of a new substance analogous to the elastic and pliable gums, India-rubber and gutta-percha; not only in many of its properties, but also in the uses to which it can be applied, and for which uses no other materials of any real value have hitherto been found. In order that a fair idea may be formed, not only of the individual but of the relative value of the several substances comprised in this paper—in regard, more particularly, to their adaptation to the requirements of a progressive civilisation—it is proposed to treat the subject as follows:—

1st. The introduction, properties, and uses of India-rubber.

2nd. The introduction, properties, and uses of gutta-percha.

3rdly. The introduction, properties, and uses of the new substance, and an explanation of the manner in which it will be found a valuable addition to our present resources in materials of a like nature.

I have found it extremely difficult within the usual limits of a paper of this description to include even a small portion that is interesting and valuable in connection with our knowledge and experience of these materials. Condensed as it is, I hope, however, it will give a sufficient idea of the commercial importance of the materials described, and of their value in affording us a larger measure of convenience and comfort than we could otherwise enjoy.

"Caoutchouc," or, as it is commonly named, "India-rubber," was first introduced into Europe in the early part of the last century, but its origin was unknown until the visit of the French academicians to South America in the year 1715. They ascertained that it was extracted from a Brazilian tree, called by the natives Hœvœ. In 1767 a specimen was first brought to England, and was sent to Mr. Canton, by Sir Joseph Banks, as "two balls of the new elastic substance." In 1772, Dr. Priestly thus speaks of the new discovery in his "Introduction to the Study of Perspective." "I have seen a substance excellently adapted to the purpose of wiping from paper the marks of a blacklead pencil; it must be, therefore, of singular use to those who practice drawing. It is sold by Mr. Nairne, mathematical instrument maker, opposite the Exchange. He sells a cubical piece of half an inch for three shillings, and he says it will last for years." This property of obliterating pencil marks first gave the name India-rubber, which it has held to this day. Naturally enough, so singular a material, and one so unlike in its nature to anything that had hitherto come before their notice, caused considerable interest amongst chemists and philosophers. Every conceivable experiment that the science of that day could suggest, was employed in the hopes of wresting from it those secrets with which nature sometimes favours earnest searchers after truth. Philosophy added some new facts to the stores of knowledge, but it remained for the practical utilitarian of the 19th century, aided by the appliances of a more advanced civilisation, viz., the rollers, masticators, and presses of a new mechanical era, to torture from it the secret of wealth, which lay dormant like its own latent heat.

There are many English weeds which, when pressed, yield a milky substance, as for instance, the common dandelion, garden spurz, poppy, &c. Humboldt, in the first edition of the "Aspects of Nature," noticed that the milky juices of plants increase as we approach the tropics. There are, in the tropical climates of Asia, Africa, and America, a large number of trees and shrubs, which produce the liquid caoutchouc, and it is obtained by exudation through punctures made in the bark. About 12 years ago, Mr. Griffith published an interesting report upon the *Ficus elasticus*, or india-rubber bearing tree of Assam. He says, "This remarkable species of fig-tree grows either solitary or in two or three field groups. It is larger and more umbrageous than any of the other trees in the forest where it abounds, and may be distinguished from them at a distance of several miles, by the picturesque appearance produced by its dense, huge, lofty crown. The main trunk of one was carefully measured, and was found to have a circumference of no less than 74 feet, or, including the supports immediately round it, 120 feet. The area covered by the expanded branches had a circumference of 610 feet. The height of the central tree was 100 feet." It has been estimated, after an accurate survey, that there are 43,240 such noble trees within a length of 30 and a breadth of 8 miles of forest near Ferozepoor, in the district of Chaduar, in Assam. Lieut. Veitch has since discovered that the *Ficus elasticus* is equally abundant in the district of Nauduar, and it is said this species extends over more than 10,000 square miles in Assam. Many other trees in various countries yield india-rubber, among which may be named, as the most fruitful, *Siphonia caoutchouc*, *Urceola elastica*, *Jatropha elastica*, *Castilleja elastica*, *Cecropia pelleta*, *Ficus religiosa*, &c. The *Siphonia caoutchouc* extends over a vast district in Central America, and the india-rubber obtained from this tree is one of the best adapted for manufactures. The *Urceola elastica* is a native of the islands of the Indian Archipelago. It is said this tree will yield from 50 to 60 lbs. of india-rubber in one season, without being injured by the drain of sap. India-rubber is thus derived from many countries in the tropics, each having its peculiar quality and value in the market.

Para, in South America, furnishes a very fine quality, much esteemed. There are, besides, East India (Penang and Siam), African (Lagos), Guatemala (Carthagena), Guayaquil, Assam (Daloore) Ceara, Barbadoes, and Mauritius. The principal imports, however, are from Para and the East Indies. The Para rubber is of very fine quality, and if not injured by masticatory processes in the manufacture, or mixed with deleterious compounds, will, under ordinary circumstances, preserve its character for an almost indefinite period, whilst the Ceara, a very inferior quality, often passes through a species of decomposition before arriving in this country, the heat of the ship's hold being sufficient to partially liquidate its substance.

The liquid india-rubber, as it exudes from the tree, is of a creamy appearance and consistency. Examined by the microscope, it is found that the particles of india-rubber are floating in the form of small globules, in a thin, watery, albuminous fluid, which, when evaporated, leaves

the india-rubber in a solid, elastic state. In this primal state, it would appear in the most eligible form for the waterproofing of fabrics, as it might then be precipitated, so to speak, on the cloth, and thereby be secured in its pure natural condition; and it seems long previous to its introduction into England that it was so used by the Spaniards. In 1723, a work, entitled "La Monarchia Indiana," was printed in Madrid, in which is described "very profitable trees in New Spain, from which there distil various liquors and resins." Amongst them is described a tree called Ulquahuil, which the natives cut with a hatchet to obtain the thick, white adhesive fluid. Of this they made balls, called ulli, which bound very high when struck to the ground, and were used in various games. He goes on to say, "Our people (the Spaniards) make use of their ulli to varnish their cloaks, made of hempen cloth, for wet weather, which are good to resist water, but not against the sun, by whose heat and rays the ulli is dissolved." India-rubber is known in Mexico to the present day by the name of ulli.

Many of the earliest experimentalists in india-rubber clung tenaciously to the idea of importing the liquid. Amongst them may be mentioned Mr. Chas. Hancock, the author of the work on india-rubber manufacture, and perhaps the most worthy to be called its originator as a manufacture. Although this idea seems practical enough at first sight, yet there are in reality difficulties and objections to it which have not yet been surmounted. The particles of india-rubber floating in the watery fluid have a most perverse way of uniting and forming lumps, or coagulating. Added to this difficulty is that of making secure vessels in a wild, savage country, and their safe transmission to the coast, independent of the extra cost of the carriage and freight of the additional liquid. An invention was patented in America for mixing some chemical with the caoutchouc to preserve the liquid condition, but I am not aware that india-rubber in this state is now anywhere employed as a manufacture.

The manner of collecting india-rubber is as follows:—A tribe or party of Indians set out in search. On finding trees they first make incisions about a foot apart, across and through the bark, round the trunk and large branches, the quantity which exudes increasing with the height of the incisions. Leaves to form vessels are placed at the foot of the tree to receive the milk which gradually streams from the wounded bark. The average quantity from full grown trees is about 40 to 50 lbs. at each bleeding; the bleeding may be repeated after the interval of a fortnight.

To reduce this milk into a state of solid india-rubber the natives make clay moulds of various shapes, the most common and usual being that of a circular bottle. When the clay is dry these moulds are dipped in a vessel containing the milk, and then hung in the smoke of a fire made with palm leaves and roots, the heat of which dissipates the watery fluid and leaves a thin film of india rubber on the mould. This alternate dipping and drying is repeated until the desired thickness has accumulated, which is usually from half to one inch. The dried clay forming the nucleus is then broken and extracted from the mouth of the bottle; though the native's conscience, possessing somewhat the elasticity of the material he operates on, overlooks sometimes this important part of the manufacture, much to the disgust of the English buyer who, perhaps, pays 1s. 6d. to 2s. per lb. for it. This is, however, a small return for the sized cottons, iron knives, axes, &c., and doctored whiskey too often palmed upon them by more civilized traders. The singular decomposition of india rubber, which, as before mentioned, in some cases occurs even during its passage home, has its origin, I feel assured, in the admixture of some deleterious matter during the process of solidification. The smallest portion of oleaginous matter would impregnate the mass and favour rapid subsequent decay. It is highly probable that the burning of oily vegetable matter in the fires employed for drying the layers may, under certain circumstances, give off such oleaginous particles to the serious injury of the india rubber.

Caoutchouc is of the class of hydro-carbons. According to the analysis of Dr. Ure, it consists of 90 parts of carbon, and 10 parts hydrogen. Professor Faraday says it is 87·2 carbon and 12·8 hydrogen; unlike most vegetable products, it does not contain any oxygen. Some of its physical properties are very remarkable and highly interesting, amongst which is the production of heat attending compression and expansion.

Mr. Brockedon, in a paper read to the members of the Royal Institution "On some properties peculiar to india-rubber," states that he raised the temperature of an ounce of water two degrees in about 15 minutes by collecting the heat evolved by the extension of caoutchouc thread.

Its resistance to enormous pressure is very extraordinary. A cube of 2½ inches, impactly secured, was subjected to a force of 200 tons. The result was a compression amounting to one-tenth. Great heat appeared to have been evolved, and the excessive elasticity of the substance caused a fly-wheel, weighing five tons, to recoil with alarming violence.

A further instance may be interesting, as regards its resistance to steady pressure. In preparing natural india-rubber (which I shall have occasion to explain more fully in the course of this paper), hydraulic pressure is employed. I have seen two bolts of 4½ inch best Low-Moor wrought-iron simultaneously torn asunder at the head, whilst the india-rubber contained under pressure has only expanded a few inches on being released from its tremendous load.

A series of experiments on the elasticity and other kindred properties of india-rubber, made under a variety of circumstances, having regard at the same time to relative phenomena, would, I feel sure, be not only eminently valuable to science, but probably open some chance of this peculiar and valuable property being imparted to other substances of a similar character, and thereby afford new and valuable materials for manufacture.

The electrical properties of india-rubber are very great, and when mixed with shellac and silica, or vulcanised into the horny state, it is an almost perfect electric, having high insulating qualities.

India-rubber may be dissolved in highly rectified ether and in some of the volatile essential oils, but none of these are valuable in its manufacture. Carefully rectified coal-naphtha is the most rapid solvent and the most easily evaporated of any, and on account of its moderate price is unrivalled. Highly rectified spirits of turpentine are also employed, but to no great extent. A very remarkable discovery was made in the year 1833, by Mr. W. Barnard, at the factory of Mr. Enderby, of Greenwich. Whilst experimenting on the impregnation of ropes with caoutchouc, he discovered that when that substance was exposed to a heat of 600° Fahr., in a retort, it was resolved into a white vapour, which by the usual method employed in distillation was condensable into a fluid having remarkable properties. In the first place, in a liquid state, it has a lighter specific gravity than any other liquid known to chemists, but in a state of vapour is heavier than the most ponderous gases. Indeed, so dense is it that it may be poured from one vessel to another like water. It has the power of dissolving india-rubber with great facility, and will dissolve copal without heat, a result never before obtained with any solvent.

As before mentioned, india-rubber was unknown, excepting as regarded its philosophical interest, until about the year 1820, when it first began to be looked upon as likely to become an important manufacture, though we find at an earlier date, in the year 1791, a patent for its use, taken out by Samuel Peak. His patent was entitled, "An improved method of making and rendering waterproof all kinds of leather, linen, cotton, &c., for the purpose of being worked up into shoes, boots, and other wearing apparel, and to be used on all occasions when dryness or a power of repelling moisture may be required." He proceeds to describe how he dissolves india-rubber by

distillation or infusion of spirits of turpentine over a brisk fire. It may be dissolved in other spirits, and in most kinds of oils, or the gum may be used with equal advantage in its native fluid state.

The next patent was that of Mr. Thomas Hancock, in 1820, for "An application of a certain material to various articles of dress and other articles, that the same may be rendered more elastic." This patent consisted in applying india-rubber to the manufacture of elastic bands for gloves, waitcoats, purses, &c., afterwards so increased in value by the invention of Mr. William Sievier, dated 1831 and 1833, for covering braiding, and weaving elastic threads, such as are now so largely consumed for elastic shoes and boots, braces, purses, bands, &c.

In 1823, Mr. Charles Macintosh took out a patent for "A process whereby the texture of hemp, flax, wool, cotton, &c., may be rendered impervious to water and air." He first describes the preparation of a varnish by dissolving india-rubber in the substance which is produced in making coal gas, commonly called coal oil. With this varnish or cement he combines two fabrics, which are thereby rendered air and waterproof. This was the origin of the famous waterproof coats; and the name of Macintosh is still employed to designate all combined waterproof fabrics. These coats will be remembered for the excessive odour they evolved, a consequence of the impure naphtha then employed, which contained a considerable amount of tar creosote, &c. This was a great source of annoyance, not only to the wearer but to the manufacturer, on account of the length of time the india-rubber solution required to dry, and the destructive action of these deleterious impurities thereon, involving active decomposition. These grave objections to the use of naphtha being brought to the notice of manufacturing chemists, a more highly-rectified spirit was soon produced.

We have now reached a point in the history of this material, when a few words, explanatory of the treatment of rubber in course of manufacture will be advantageous, as rendering more intelligible what will subsequently come under our consideration. Each manufacturer has some favourite plan of manipulation or peculiar arrangement of machinery, but all based on the same principle. For most of the purposes for which rubber is applicable, its peculiar intractability whilst in the solid natural state, prevents its manipulation into the desired forms until rendered more plastic and yielding; but solvents act very slowly on the natural substance, whilst in the form of block, lump, or bottle. The resistance to compression, we have previously noticed, is a barrier to the use of rolling mills, at least, as far as its reduction into a fine, even sheet is concerned. It was therefore found necessary to have recourse to some mechanical means, whereby the structure of the India-rubber might, as it were, be broken down, and its extraordinary cohesive power be temporarily overcome.

To the schoolboy of former days must we ascribe the discovery of a process whereby this might be accomplished. We, many of us, may remember the favourite amusement of some who, ever ready to beguile the lingering school hour, would render more attention to the production of a good India-rubber "pop" than to their Euclid or Virgil. Their process was the continued mastication of a piece of rubber, about a ¼-inch cube, until it became so soft and plastic that, by pulling it into a thin membrane, and then folding it over edge to edge, an air cavity or bubble was formed, the air in which, exploding by pressure between the thumb nails, produced the crack or "pop" it was their delight to accomplish, and to which end they had perseveringly continued the mastication some two or three days, in spite of aching jaws. No one who would try the operation for a few minutes will deny that a prominent feature of English character is in early life developed by this determined and continued exercise of the school-boy's molar powers. This illustrates then the treatment necessary, as we before said, to overcome the great cohesive power. Machines, called "Masticators," were invented, consisting of a cylinder of cast-iron, mounted on a suitable frame. A central shaft, armed with coarse teeth, revolves in it; there is a grated door in front, to fill or empty it. It will be perceived that when India-rubber is put into this cylinder, the revolving shaft will give it motion, and, by continual mastication by these powerful teeth, added to the heat with which the enormous friction is attended, it will be speedily reduced into a uniform homogenous mass. Water is admitted into the cylinder to wash out any impurities in the rubber. It is then transferred into a dry masticator, and there worked longer, until all the moisture it contains is completely evaporated. Well-made and true rollers will then bring it down into a thin sheet, like paper, and it may be dissolved either into "varnish," or the more solid "dough," as it is called, by the digestion of the sheet in more or less naphtha, aided by mechanical friction, a very short time being necessary to do this after the structure of the India-rubber is so thoroughly altered.

In order to make a fabric impermeable to air or water, a machine called a "guage spreader" is employed. The cloth to be rendered proof is wound on a roller at one end of the machine; from this roller, after passing over straining bars, to preserve the cloth from creasing, as well as to secure a regular tension of the fabric, it passes over a truly-turned iron roller—having a guage or knife fixed above it, provided with screws to regulate the amount of varnish or dough it is desired to lay on the fabric—from this guage the cloth passes over and under a steam chest, whereby the naphtha is evaporated, and it is then rolled up. The cloth being disposed in the order described, and the knife adjusted to the desired guage, a quantity of the viscid varnish or dough is placed in front thereof, and the machine then set in motion. If a fine surface and a thick substance is required, several layers are put on in succession. If a double texture or macintosh cloth is desired, two fabrics are coated, and are, whilst in an adhesive state, united by passing them face to face between a pair of rollers, which produces a compound fabric, perfectly water and air proof.

Sometimes the India-rubber dough is spread by means of rollers having polished or smooth surfaces, by which a good effect may be produced in one operation, but from various causes it is not the most economical plan.

For moulded and vulcanised forms the dough is intimately combined with finely-divided sulphur in mixing rollers, and then put into moulds of the desired form, and exposed in a vulcanising oven to a heat of from 240 to 260 degrees Fahr., for a space of time varying with the size and purposes to which the materials are afterwards to be applied. Where hard compounds, called vulcanite, are desired, the heat is considerably increased, by which the process is carried a stage farther, and the India-rubber changed into a substance having all the appearance of horn or ebony, but having still considerable elasticity. The merit of the invention of India-rubber vulcanisation is due to Mr. Charles Goodyear, of the United States, who patented it there. It was afterwards patented in this country by Mr. Thomas Hancock, and Mr. Charles Goodyear was thus restrained from importing his vulcanised India-rubber into England. This very important improvement, whereby rubber was rendered almost unaffected by change of temperature, insoluble, and less susceptible of injury from contact with oil or grease, gave considerable impulse to the application of this substance.

The extensive and varied uses to which India-rubber is now applied, furnish a striking example of the shortness of our mental vision in perceiving, even faintly, the destiny of new discoveries, for no individual appears at its introduction to have possessed the prescience of its future importance.

It is impossible for the ordinary observer to appreciate fully the advantages derived in additional comfort and convenience from this simple substance, unless by inquiring into the various and multitudinous applications which represent its utility. The metamorphoses it under-

goes in the hands of man, when subjected to his skill and ingenuity, would be something marvellous in any other times than the present era of steam and electricity. Derived from the milk of a tree, it comes to us as a shapeless lump; but the Hancocks, Macintoshes, and Warnes—genii of the gum—so mould and fashion it to their will, that it issues from the manufactory—to suckle our children—to ward off the severity and sharpness of our climate—to relieve the pains and suffering of disease—and, when old age brings on us the loss of our most estimable instruments, the teeth, it furnishes the means of replacing them.

A large amount of practical knowledge and scientific research has been directed to this manufacture, and the results have proved eminently creditable to those engaged therein. Foremost amongst these workers may fairly be ranked Mr. Thomas Hancock, to whom the manufacture mainly owes its origin and development; but there is besides a long string of names of those who have rendered valuable service—Goodyear, Parkes, Brockedon, Sievier, Keene, Macintosh, Nicolls, Woodcock, Jaques, Fanshaw, &c., have each given their meed of intelligence and ingenuity.

In describing the uses of india-rubber, they will be taken in the following order:—

1. Domestic uses.
2. Manufacturing uses.
3. Surgical and Dentistry.
4. Miscellaneous.

First, then, in Domestic uses:—We have a door-mat, not long ago introduced by Messrs. Warne and Co., of Tottenham, but which is in considerable favour, judging from the number to be seen in use. It is formed of strips of vulcanised india-rubber, cemented endways in a honey-comb pattern, the extreme elasticity of the ribs serving to remove the dirt very effectively, and allowing it to drop into the bottom of the mat, to be easily removed at any time.

A manner of making floor-cloth was patented by Elijah Galloway, in 1844; it consisted of combining india-rubber with a large amount of cork, and then rolling it into a substance about one-eighth to three-sixteenths of an inch thick, which may be printed with oil paint by the ordinary floor-cloth printing blocks. This material was called Kamptulicon, and has increased in public favour so much that there is now a considerable demand for it. Its qualities are, noiselessness when trod upon, rendering it admirably adapted for churches, banks, nurseries, libraries, billiard-rooms, or any place where quietness is desirable. Its resistance to wear and damp make it much more durable than oilcloth.

For closing doors, india-rubber springs act noiselessly and easily. Slips of india-rubber, cemented on the edges of doors and windows, exclude air and prevent draughts, as well as causing doors to close without noise or jar.

The beautiful mosaic wool hearth-rugs, manufactured by Messrs. Crossley and Sons, of Halifax, are produced by an ingenious process, which shows the value of india-rubber as a cement. Threads of coloured wool are disposed in a large frame, or box, in such order, that when a section is shown it shall represent some design that is being copied. The frame being filled, it is consolidated by pressure, and by means of a large semicircular knife a sectional slice is cut off to straighten the block; a sheet of linen, the size of the block, and uniformly besmeared with india-rubber cement or varnish, is then pressed against the face of the block of wool, until it adheres firmly to it; the action of cutting a thickness of the wool sufficient to form a rug pile, is then repeated, until the block is all cut up; the rugs are afterwards submitted to pressure to ensure secure adhesion. This cement will hold the wool as firm as if woven into the foundation.

Mr. Charles Goodyear introduced furniture veneers made of vulcanite, in imitation of ebony. A series of examples of vulcanite veneered furniture may be seen at the Crystal Palace, Sydenham, in Mr. Goodyear's court, with many other applications of it, such as buttons, knife handles, &c. Mattrasses made of air and waterproof fabrics, and inflated with air or water, as made by Messrs. Ayckbourn and others, often afford relief to the aching limbs of long bed-ridden invalids when other mattresses are painful. Waterproof coats and capes, although not considered wholesome to be worn for long, especially if made close fitting, are extremely valuable to those whose avocations expose them much to our extremely changeable climate. Bags made of waterproofed silks are largely used as sponge bags, and also bathing caps. The mother can bear testimony to the value of nursing aprons, feeding-bottles, gum-rings, and many other little appliances which render valuable service in the nursery.

In the kitchen we have a very useful application of the combined india-rubber and cork, before mentioned, called Oakey's patent knife-board, being a sheet of kamptulicon cemented on wood. It is extremely efficacious; being elastic, it yields to the knife, admitting the production of a high polish without scratches.

Flexible india rubber tubes, for the conveyance of water, are most valuable appliances for the bath-room, stable, or garden. Hard india rubber or vulcanite, possessing great hardness, durability, and capacity for taking and preserving a fine polish, forms a very suitable material for small articles or toilet requisites. Tooth, hair, and nail brush handles are made of it, in imitation of plain or carved ebony, admitting of the finest finish; combs also, having the appearance of horn, with perhaps more durability and elasticity, have been largely manufactured in Paris. Some of these combs are remarkable for the great amount of electricity generated by the friction of the hair whilst combing it; so considerable is the amount with certain individuals, when using a comb in my possession, that the action may not only be felt but a regular succession of slight discharges may be distinctly heard. It is this property which renders vulcanite one of the most valuable electrics we possess; and there can be no doubt that for electric telegraph cables, if, in addition to hardness, it could possess sufficient pliability, it would be the most perfect material we have, provided always that its manipulation was as facile. As supports or insulators for overhead telegraph wires, Messrs. Silver and Co. have been making, for some time, ebonite insulators.

Vulcanite and ebonite are moulded into knife-handles, either plain and polished, or in ornamental design, and in imitation of buck horn. Most beautiful buttons, with the finest lines and impressions imaginable, are made largely by india-rubber manufacturers in Paris.

Book-backs, paper-knives, pencil-cases, bobbins, needle-cases, bracelets, chains, crosses, rings, &c., are moulded of this material and then polished, the bracelets, &c., being a perfect imitation of jet. A most interesting example of its uniformly resilient property is its application to the cushions of billiard tables.

2ndly, its uses in manufactures. These are very numerous and important. Driving bands, formerly made exclusively of leather, are now made largely in india-rubber, which, in addition to their qualities of working equally well in damp or dry rooms, outside or in, are lower in price considerably. They are made by combining layers of cotton or linen cloths by india-rubber cements, and then coating the surface with finishing material and vulcanizing them in moulds. The North British Rubber Company, of Edinburgh, have almost the monopoly of this strapping, having machinery specially adapted for every process in the manufacture.

Hose pipes, for conveying water, beer, or other liquid from one vessel to another, or for extinguishing fires, are durable and considerably cheaper than the old-fashioned rivetted leather hose.

Packings for the joints between steam, water, and air pipes, consisting of vulcanised india-rubber rings or alternate layers of cloth and rubber, have almost entirely superseded the old packings of pasteboard, hemp, and white-lead, on account mainly of the economy of time and labour, and more certain success attained thereby. The

elasticity of these packings permits the rough unturned flanges of two steam pipes to be made perfectly steam tight without the more expensive operation of facing the pipes in the lathe. Valve and piston packings are also much used. Perhaps the most philosophical application of india-rubber to manufactures is that of Mons. Perreaux's valve, which may be advanced as an example of the valuable ideas that inventors and manufacturers may derive from a careful and earnest study of the economy of nature. This valve, formed entirely of vulcanized india-rubber, is an imitation of valves found in the human body. It is formed of two powerful projecting lips, described in the patent as resembling the mouthpiece of the musical instrument called the hautboy, which are fitted in a pipe. The water flowing in one direction opens them with the slightest pressure, but when the current of water reverses, it closes the lips instantaneously, and they will not permit the water to return. The action of this valve is very perfect, and it may be worked in water containing bits of wood, cinders, &c., as the valve mouths, being perfectly elastic, will close upon them without any leakage, and free themselves the moment the pressure is reversed.

In the ingenious envelope-machine invented by Messrs. De la Rue and Hill, one of the most effective and necessary appendages is a bit of burnt india-rubber. This material, when burnt on the surface, retains considerable adhesiveness for months, and will adhere to any light substance pressed against it. It can easily be imagined that considerable difficulty would arise in inventing mechanical instruments or fingers to lift up and transfer these envelopes from one part of the machine to another. Levers are made with a lifting and transferring motion, armed at their extremities with bits of burnt rubber. The action is similar, of course, to that of lifting wafers by wetting the fingers to cause momentary adhesion. This arrangement fulfils everything required of it.

Cards (or wire brushes, as they may be termed) used for carding wool and other fibrous substances, as well as now employed for raising the nap upon woollen cloth prior to shearing, and for producing certain kinds of finish, are also made with rubber. These were formerly made of leather, in which were set the wire staples, dents, or teeth, which in the process of carding disentangle and straighten the fibres. In order to increase the elasticity of the foundation wherein these wires were set, my father, Mr. James Walton, of Haughton Dale, near Manchester, patented, in 1834, the application of sheet india-rubber cemented to linen and cotton fabrics, for the backs or foundation of cards, the success of which has been so great, that the india-rubber has now almost entirely replaced the leather for this purpose. Finding, shortly after the commencement of this new manufacture, that the process of mastication of rubber was highly injurious, where it had to be used afterwards in warm temperatures, he invented a series of machines whereby the rubber may be produced in an almost endless sheet, without any mixing, masticating, or rolling process, and preserved throughout in the same pure, natural condition and structure as imported. This is effected as follows:—The india-rubber is cut up by a machine into fine mincemeat. It then passes through a washing and purifying process, and is afterwards submitted to a strong dry heat, by which means all moisture is evaporated, and in a few hours an adhesive character is given to every surface of the particles. It is then placed in extremely powerful hydraulic presses, and pressed into a solid circular block, or cylinder, about 50 inches long and 36 in diameter, with a hole through the centre, in which a shaft is forced. This shaft, having centres, can be placed in a cutting machine, and by it the block of india-rubber can be cut into a continuous equal sheet of pure natural rubber, which, from the different colours of the pieces of india-rubber composing it, has the appearance of a piece of brawn. This sheet of natural india-rubber is then cemented to cotton and linen fabrics, which give strength to resist great strain during work. Whilst on the subject of this application, it will, I think, be interesting to diverge a moment to a sketch of the machines employed in setting the wires into the india-rubber foundation, which is allowed generally to be one of the most perfect automatic mechanisms known, more particularly in regard to the wonderful speed and precision of its movements.

This machine, as first employed for setting cards, was introduced by Mr. Chas. Dyer, but was slow and cumbersome. My father invented an improved machine, which, although only about two feet square, is composed of 338 distinct parts, forming instruments for 12 different movements. This machine sets 240 dents or teeth per minute. For each tooth set it has to draw forward the wire, to cut it into lengths, to bend it to the form of a staple, to prick the hole in the india-rubber, to insert the staple therein, and afterwards to bend the staple or tooth behind, besides many auxiliary movements, such as a stop motion to stop the machine instantly, if any defect in the wire arises. At our mill at Haughton Dale there are 450 of these machines, besides all the wire, india-rubber, and cloth factories. In one room are 189 machines, which cut and set 45,360 teeth every minute, consuming in this one room every year above 128,000 miles of wire. The consumption of rubber in our mills alone for card making is usually about 2½ tons per week.

But to proceed with our uses of india-rubber. We next notice its application to drawing rollers of spinning frames for cotton spinning, instead of leather; but, partly on account of an electrical action, which excites and attracts the fibres, it never succeeded. We have then cotton felt, cemented into sheets (according to Clarke's patent) with india-rubber, used largely as a waterproof wrapper for packing Manchester and other goods. This felt, coloured with pigment, varnished, and embossed, makes a good imitation leather for bookbinding, for purses, &c., as patented by Fitch. Paper and cloth are also combined with india-rubber cement, as described in a patent of my own for imitation leather.

Shuttles for weaving, valve-boxes for acid pumps, and pipes and buckets for acid manufactories, are made of vulcanite. In manufactories where corrosive acids are, this material is valuable from its resistance to the corrosive action of such liquids. Hydraulic ram leathers have been tried, but with indifferent success.

Gas holders for gas works have been made and sent abroad. India-rubber combined with shellac forms the celebrated marine glue, so much used in ship-building for uniting masts, by glueing the splices with this cement, and which is so tenacious as to hold the splices so firmly that it has been repeatedly proved that the mast will break at any other point than the joint.

3rdly, we take Surgery and Dentistry. Here it is largely used; mostly in the hard state for knife, saw, and lancet handles, caustic holders, syringes, stethoscopes, and many other valuable appliances, the smooth and polished surfaces obtained on these articles, allowing them to be easily cleaned. Dissecting gloves of vulcanised india-rubber are valuable to the anatomist for the protection of the hands from any putrid poisonous matter.

Elastic stockings, for the cure of varicose veins, &c., waterproof sheets and bandages, truss-pads, air and water cushions, are all useful in the hospital and surgery. Flesh vulcanised rubber, coloured to imitate the gums, is now largely prepared by the manufacturers and supplied to the dentists, who, taking a mould of the mouth in wax, remodel it in plaster of Paris. This is then dried, and the artificial teeth inserted in the cavities, and the gum-coloured rubber is pressed into the mould until well fitted. An iron frame is then secured round the whole, and it is placed in a small vulcaniser, heated by gas, and provided with a thermometer, and then undergoes the necessary amount of vulcanisation to change it into a hard substance like ivory, but of the requisite colour just named. It is cleaned and polished, and is then ready for use. Artificial palates are also thus made, and dentists can attest nu-

merous cases where much suffering and inconvenience has thereby been alleviated.

4thly. In Miscellaneous Uses we have cricketing gloves, foot-balls, children's balloons, horse knee-caps, greyhound stockings, noiseless truck and carriage wheels, sheep stockings (to prevent rot), buffers for the horns of dangerous cattle, waterproof mail bags, to preserve letters from the effects of wet and moisture; tobacco-pouches, so much prized by smokers for the moist state in which they keep the tobacco.

Thus I have completed my list of the uses of this material, but there still remain very many valuable applications not noticed here. The examples given will sufficiently convey to you how important a branch of manufacture this has become.

The statistics that I will now submit to you will show the production of Para rubber; the imports into Liverpool; stocks in London; and the average maximum and minimum price during several years. Although statistics on this subject are not procurable for many years back, the following are to be depended on as from good authority:—

Production of Para rubber in—

1853	1,800	tons.
1854	1,926	,,
1855	2,400	,,
1856	1,900	,,
1857	2,066	,,
1858	1,700	,,
1859	1,807	,,
1860 and 1861	No record.	

The imports into Liverpool from 1858 to 1861 are as follows:—

1858	428	tons.
1859	696	,,
1860	1,065	,,
1861	1,423	,,

The stocks in London in—

1857	775	,,
1858	719	,,
1859	326	,,
1860	192½	,,
1861	399½	,,
1862	715½	,,

Maximum price of Para rubber in—

1856.	1857.	1858.	1859.	1860.	1861.
1s. 11d.	1s. 11d.	1s. 9½d.	2s. 6½d.	3s. 0d.	2s. 2d.

Minimum—

1s. 5d.	1s. 6d.	1s. 6d.	1s. 11d.	1s. 3d.	1s. 9d.

As far as can be judged, the demand in this country has been regularly and rapidly increasing; the production, on the contrary, does not increase in proportion. In the year 1835, the price of rubber was about 6d. to 8d. per lb. for fine quality; the same quality in 1860 was 3s.; in 1861, 2s. 2d., and now about 1s. 11d. to 2s. The price every year appears likely, from the recent quotations, to increase rather than otherwise.

Gutta-percha. This article was almost entirely unknown to commerce, even by name, as late as the year 1844, although it is said to have been brought to England in the days of Tradescant, "king's gardener" to Charles the First; and it is believed to have been shown in Tradescant's Museum, under the name of Mazer wood, of which bowls and goblets were formerly made. Subsequently it was often brought from China and other parts of the East, in the form of elastic whips, sticks, &c.

Gutta-percha is obtained from the Isonandra Gutta tree, of the order *Sapotaceæ*, or gum-exuding *genera*. The discovery of gutta-percha, as a substance of commercial value, is due to Dr. Montgomery, an assistant surgeon of the Residency of Singapore. Whilst one day watching a penang, or native woodcutter, at his labour, he was struck by the appearance of a hatchet or chopper which he employed. The handle seemed to be formed of some material very different from those he had before seen. On questioning the man, he found that the material of which it was made could be moulded into any form, by dipping it into boiling water till it was heated through, when it became plastic as clay, regaining, when cold, its original hardness and rigidity. Seeing the importance of a substance possessing such properties, he first ascertained how it was procured, and finding it to be derived, like caoutchouc, from an inspissated juice, he then procured specimens in various stages of preparation, and sent them to the Society of Arts in London; for this discovery of a new substance valuable to the Arts and Manufactures they afterwards presented him with the Society's gold medal. As the natural history and manner of collecting this gum has been so often described in the journals of this and other societies, and as the introduction to public use and notice is in a great measure due to the publicity thus given, it would be presumptuous on my part to give more than the preceding sketch thereof.

Mr. Chas. Hancock, in his patent of 1846, claimed the application of gutta percha to a large number of purposes for which it had never been before employed; and to his exertions, and the enterprise of the Gutta Percha Company, is the development of its manufacture and applications mainly due.

The manufacture of gutta percha requires a series of cleansing, kneading, and moulding machines, for the crude lumps as imported contain large quantities of foreign matter, such as bark, stones, &c. To effect a separation of extraneous substances, the rough blocks are first cut into slices, by a vertical wheel, faced with knives, making 200 revolutions per minute. The slices are then sorted over, and any gross matters removed, and after boiling in water the doughy mass is put into an iron box, or tearer, in which an iron cylinder, with iron teeth, rapidly revolves tearing it into shreds, and then throwing it into cold water. There the gutta percha floats on the top whilst the impurities sink to the bottom. It is then transferred to tanks of boiling water, and afterwards put into masticators, to be kneaded into a dry uniform dough. If it is desired to make this dough into sheet for shoe soles, driving bands, &c., it is rolled out between smooth rollers to the desired guage or thickness. In making tubes and pipes the dough is put into cylinders furnished with pistons, and having a die at one end of the cylinder, through which the gutta percha is forced in a continuous length of finished pipe. There are two cylinders to each moulding machine, so arranged that one can be charged with the dough whilst the other is discharging through the die—thus obviating the necessity of stoppages. In coating telegraph wires a very similar disposition of machinery is employed, the wire to be covered being passed through a die sufficiently large to allow the layer of gutta percha to be kneaded or moulded upon it, in its passage through the cylinder, guides being employed to preserve it as near as possible in the centre of the coating. To ensure a perfectly solid and impermeable coating, which shall be proof to the greatest weight of water which it can be exposed to, when used for deep sea cables, several successive layers are moulded over each other, the chance of any air-bubbles or defective places occurring several times in the same place amounting almost to an impossibility. The wires thus coated are then submitted to a very searching test, whereby the slightest fault is made visible. This admirable system of testing telegraph cables is the invention of Mr. Wm. Reid, telegraph engineer, who has applied an ingenious arrangement, whereby delicate electrometers can be made to indicate any defective point in a cable whilst under a pressure of many thousand pounds per square inch.

The capability of taking any form given to it whilst in the plastic state, renders the use of presses, dies, and models very valuable in its manufacture, especially in ornamental work. It will suffice, in describing its uses,

to read a list issued by the Gutta-Percha Company in their circular of 1850, which will show how varied are the applications it is capable of. It is true many of the uses here stated have not succeeded as well as sanguine promoters anticipated, still there have since arisen many valuable additional applications, which, in some measure, compensate.

The Gutta Percha Company's list, as before mentioned, is as follows:—

Domestic uses.—Soles for boots and shoes, lining for cisterns, picture frames, looking glass frames, ornamental mouldings, bowls, drinking cups, jars, soap-dishes, ornamental inkstands, vases, noiseless curtain rings, card, fruit, pin and pen trays, window-blind cord, clothes line, imitation fringe, coloured materials for amateur moulding, ornamental flower stand and pots, sheeting for damp walls and floors, conveyance of water, gas, &c., drain and soil pipes, tubing in lieu of bells, tubing for watering gardens, washing windows, &c., lining for bonnets, jar-covers, sponge-bags, watch-stands, foot-baths, lighter-stands.

Manufacturing uses.—Mill-bands, pump-buckets, valves, clacks, felt edging for paper makers, bosses for woollen manufacturers, flax-holders, shuttle beds for looms, washers, bowls for goldsmiths, bobbins, covers for rollers, round bands and cords, breasts for water-wheels.

Surgical uses.—Splints, thin sheets for bandages, stethoscopes, ear-trumpets, balsam for cuts, bed-straps, thread, bed-pans for invalids.

Electrical and Chemical.—Covering for electric-telegraph wires, insulating stools, battery cells, handles for discharging-rods, electrotype moulds, carboys, vessels for acids, syphons, tubing for conveying oils, alkalies, &c., flasks, bottles, lining for tanks, funnels.

Uses on Ship Board, &c.—Sou'-wester hats, life buoys, buckets, pump buckets, hand speaking-trumpets, drinking cups, powder flasks, fishing-net floats, sheathing for ships, water-proof canvass, air-tight life-boat cells, tubes for pumping water, round cords, lining for boxes, speaking tubes.

Ornamental Applications.—Medallions, brackets, cornices, console tables, an endless variety of mouldings in imitation of woods, for the decoration of rooms, cabinets, &c., picture frames.

Agricultural Purposes.—Tubing for conveying liquid manure, lining for tanks, driving bands, &c., traces, whips.

Office Uses, &c.—Inkstands, ink cups, pen trays, cash bowls, washing basins, speaking tubes, book covers.

Miscellaneous.—Suction and delivery pipes for fire engines, fire and stable buckets, linings for coffins, tap ferules, communion trays, ventilating tubes, hearing apparatus in churches for deaf persons, cricket balls, portmanteaus, police staves, life preservers, embossed book backs, embossed globes and maps for the blind, railway conversation tubes, miners' caps, lids for paper-cutting machines, skate bottoms, &c.

At the present time the most valuable application of gutta-percha is undoubtedly that of telegraph wire insulation. Its easy manipulation and high insulating property render it peculiarly applicable to this purpose, but its liablility to soften at comparatively low temperatures is a very objectionable defect, which it is most desirable to obviate.

Gutta-percha tubing it is said, will resist a pressure of 500lbs. to the square inch.

Its acoustic properties are also very extraordinary, which makes it well adapted for speaking tubes. Its resistance to the action of corrosive liquids makes it very valuable for vessels and instruments employed in acid works. Enough might be said of the properties and uses of this material to occupy a large volume, but I must refer you to the numerous publications on the subject, written by those who are more acquainted than myself with its advantages, and would take this opportunity of saying, I should gladly, had it been possible, have referred more specifically to the names of many who have lent their valuable aid to the development of the uses and applications of india-rubber and gutta-percha.

Having reviewed the introduction and uses of india-rubber and gutta-percha, it remains for me to present to your notice the new substance and its treatment, referred to at the commencement of this paper as its leading feature; and I believe, making due allowance for the usual sanguine temperament of inventors, I shall be enabled to place before you such particulars in relation to my discovery as will convince you of its value, scientifically and commercially, and that you have not conferred so much kind and patient attention on an unworthy subject.

Numberless attempts have been made to produce a material possessing the qualities of India-rubber, and this material, together with gutta-percha, has been distorted into all forms, and has been compounded, in a most heterogenous manner, by a host of experimentalists seeking to produce a cheaper material, but no valuable results have been arrived at. The cheapest base for experiment had, I humbly submit, been neglected. It is well-known that linseed nut and poppy oils possess that nature, which distinguishes them from lubricating oils, of becoming concrete on exposure to the atmosphere; that is, that when spread in a thin layer on a surface of wood or iron, they dry or change into a thin skin. This change, which is erroneously called drying, is produced by the absorption of oxygen and the disengagement of carbonic acid, and is, in reality, only a change of their elementary constitution.

This property of absorbing oxygen rapidly is not considerable in the crude or raw linseed oil, but it is very greatly increased by boiling the oil, that is, exposing a large quantity of raw oil to a strong heat in a cauldron, with a small per-centage of metallic oxide of lead added. It is then called "varnish," and has a more viscid character, and is also rather more highly coloured. A layer of this oil requires from 6 to 24 hours to dry or change into a skin-like substance, according as the state of the atmosphere is more or less favourable.

I cannot do better than give to you a detailed account of the circumstances which combined to bring this subject before my notice. Whilst engaged, about two years ago, in a series of experiments on the manufacture of artificial leather, it was of the greatest importance to the success of the material that it should have a coat of fine varnish, which, whilst drying quickly, possessed the flexibility of india rubber. Copal varnish has always been accounted the best varnish, but made with drying oil combined with gum copal at a high temperature, it will not, of course, be dry until the action of oxidation has reduced the oil contained therein into a solid film. Whilst revolving in my mind this knotty difficulty, and presenting every phase of it to careful thought, it suddenly occurred to me that if the oil was first dried into a skin, like those I had often seen on paint cans, but, like other people, had before considered as waste, was dissolved in a volatile solvent, like India-rubber sheet—that the semi-resinous material would immediately on the evaporation of the solvent, resume, like India-rubber, the form it was in prior to solution. By dipping panes of glass into linseed oil, and allowing the films or layers to dry, then repeating the process, I imitated the manufacture of India-rubber from the milk, and thereby produced a solid elastic substance, composed of many layers of perfectly oxidised oil. Up to this stage I had done nothing new or original, for the oil sheet manufacturers have for more than a century waterproofed linen by layers of oil. But to treat this semi-resinous matter and render it available to purposes of manufacture, will be admitted to be perfectly new, and I now proceed to describe the invention. Having accumulated a quantity of solid oxidized oil by drying it upon extensive surfaces of any kind, such as prepared cloth, stretched in frames, as described in my patent of the 27th January, 1860, I then scraped or peeled it off by suitable means.

At first, as before stated, my attention was solely directed to the attainment of a speedily-drying, flexible

varnish at a moderate temperature, but very few experiments with this oxidised oil led me to notice its rubber-like qualities, which I at once conceived might, with further manipulation, and with some combinations, be developed more fully, and become a very valuable substitute for that article.

Encouraged by success at every step, I proceeded, and soon found that by crushing the solid oxidised oil obtained in sheets as described in my patent, and working it thoroughly in hot mixing rolls, I produced a substance which required only the cohesive nature, which in the early part of this paper we noticed as existing so strongly in india-rubber. The addition of a small proportion of shellac soon gave that which was wanting, and I found in my power a material singularly like caoutchouc when worked into dough, and which could be rolled on to fabrics in the same manner and with the same facility—giving a perfect waterproof cloth, unlike oil cloth, but having the rubber finish and flexibility. Pigments could easily be added to give colour; the addition of resins gave other, or rather varied proportions of adhesion, useful as affording the means of uniting fabrics as by rubber. Fibre, whether flock or cork, mixed in and rolled into sheets, gave me samples of kamptulicon and other floor-cloths.

These experiments were made more than two years since, and some of my earliest samples are now on the table before you—together with many of more recent date which I have yet to refer to; and beside them you have similar productions in rubber, which will enable you to make a comparison. Although I had thus accomplished more than my first anticipations, my primary object was yet unrealized, and I had, day by day, proofs of how entirely I was dealing with a substance of which the characteristics were entirely unknown to us. Various were the solvents tried to dissolve it. Obtained from oil it was unaffected by oil; no longer did it retain any unctuous matter, one of the greatest proofs practically of which is, that whilst any oil or greasy matter will destroy india-rubber very speedily, yet they have no effect on this; the two may be well combined. For a long time was I baffled in every attempt to find a solvent. Any heat short of carbonising it had no effect on the material, and here was evident a great advantage over rubber for practical purposes, if other desiderata were accomplished. At length I was able to dissolve this converted oil in alcohol and wood spirit—thus did I obtain the first varnish. Sufficient success had thus attended my labours to justify, at any rate in my own, perhaps sanguine mind, my patenting the discovery in England, France, Belgium, and America, and taking and fitting up works for the production of the material. But yet much remained to be achieved; the process was slow, the solvents were expensive, and did not offer all that was desired in the way of varnish. It was also desirable to obtain a medium state answering to the india-rubber cement or dough capable of being worked by the guage spreader which I have this evening described to you, and in which it would dry as rapidly, that is, within a few minutes of its passing the machine, this last requisition creating no small part of the difficulty. Some months more of diligent experiment led to more definite results, and at length I was enabled, by experiments which involved much time and labour, to perfect the solution in the distillates of coal, preferring the usual rubber solvent, naphtha. Thus was the material brought still further into a state so nearly resembling rubber solution, or cement, that even those most accustomed to the manufacture thereof could not distinguish one from the other, and in all respects it could be treated in the same way. Samples of the varnish, of the cement, and of the dough, I have also the pleasure to present to your notice. I would here remark that the success of this discovery is mainly due to the perseverance of my partner, Mr. Richard Beard, junr., who, with the same energy he devotes to the business department of our works, more especially under his care, has rendered me great assistance in these and later experiments.

Not only has this singular product been thus assimilated to rubber for uses on fabrics, or combined with fibre for floor cloths, but, still more strange, it is capable of being worked with pigment and vulcanised exactly as india-rubber has been described to be, and forms a hard compound like vulcanite and ebonite, excepting that the sulphur is not necessary. Pieces thus hardened are also placed on the table before you.

Having now explained the means of obtaining, treating, and applying this oxidised oil—its wonderful similarity to rubber must, I think, be apparent to all. I then submit that the process of solidification of the oil is identical with the drying and solidification of the rubber on the clay moulds I have in this paper referred to, with this difference, that with the rubber it is an evaporation of the fluid which holds the particles in suspension, in order that they may coalesce, and thus, of course, there is a loss of weight, whereas with the oil there is an increase of weight (ascertained by accurate experiments) from the absorption of oxygen. Chevreul confirms this point in his researches on oil painting.

The applications of my prepared oxydised oil are not limited to its uses as a substitute for rubber, as will be seen by the following list, but before passing on to its other applications, we will notice its advantages over rubber. 1st. The great difference in price which must ever exist from the facility with which one can be produced in the natural state over the other, for abundant as are the various trees yielding caoutchouc, the difficulty of collection, and scarcity of labour in regard to quantity obtained, must always keep up the price of natural rubber, whilst the linseed from which the oil is obtained can be so easily and cheaply cultivated.

The import of linseed in—

	Qrs.		Tons.
1858	1,017,844	equal to tons of oil about...	50,900
		Of which were exported ...	26,000
		Leaving for home use.....	24,900
1859	1,270,911	equal to tons of oil about...	63,600
		Of which were exported ...	30,000
		Leaving for home use.....	33,600
1860	1,330,623	equal to tons of oil about...	66,500
		Of which were exported ..	37,000
		Leaving for home use.....	29,500
1861	1,160,270	equal to tons of oil about...	58,000
		Of which were exported ...	32,000
		Leaving for home use.....	26,000

2nd. That being unaffected by oil or grease it is more durable than rubber in many of its applications, especially where used in various manufactures, such as cards for carding wool, printers' blankets, &c. That also for purposes where rubber is injured by temperature, this is unaffected. And last, though not least, its durability, inasmuch as it is free from those elements of decomposition which, it is admitted, are set in action by the very process that it is necessary for the rubber to undergo in course of manufacture, not to notice the numerous combinations therewith in use, in too many instances, on account of the high price of the pure material.

List of Applications.

Surface Fabrics.—Clothing, carriage aprons, cart sheets, sail covers, bath sheets, nursing aprons, sponge bags, &c.

Imitation Leathers.—Carriage lining, chair covers, boot and shoe leathers, trunk covers, saddlery, bags, reticules, &c.

Common Surface Fabrics.—Packing cloths and papers, cart-sheeting, tarpauling, brattice cloths for collieries, &c.

Double Textures.—Clothing, mail bags, hospital sheet-

ing, card cloths, printers' blankets, water and air beds, cushions, &c.

Manufacturing Purposes.—Packing for steam, water, and gas pipes, valves, machine banding, hose-pipes, tubing for carrying beer, &c., flax-spinners' bosses, calendering and embossing bowls, cop tubes, telegraph supports, or insulators, tank linings, ship sheathing, roof coverings, shoe soles, &c.

Hard Compounds (of any colour.)—Knife and fork handles, surgical instrument handles, surgical and dental appliances, tubing for chemical vessels, picture frames, trays, mouldings, furniture ornamentation, panelling, veneers to imitate marble, ivory, ebony, and other woods, &c.

Miscellaneous.—Washable felt carpets, kamptulicon (of any colour) stair coverings, toilet mats, table covers, &c.

Flexible quick-drying varnishes. Paints for carriages. Painting or printing floor-cloth, table-cloth, &c. (will dry in a few minutes), enamels, of any colour, for enamelling papier maché, metals, &c.

We now pass to the advantages to be derived in the use of the material under consideration, for some of the purposes in the foregoing list, to which boiled oil has hitherto been applied; and first we notice the important article of leather-cloth, commonly called American leather-cloth. This is prepared by coating the fabric with oil boiled to a thick consistency, mixed with black pigment. This is spread on cotton fabrics, which is placed in a temperature of, say from 120 to 150 degrees, for a day, to dry or oxidize the oil coating. For convenience of hanging, these are in twelve-yard lengths, and this operation has to be repeated for five or six successive days, according to the thickness of the coating required, and lastly, in the same manner, a coat of copal varnish is given, each of these requiring the same length of time to dry. Thus seven to eight days are requisite to prepare the cloth for the embossing rollers. By the use of oxidized oil, properly prepared, you have all the same qualities as are obtained by allowing the oil to oxidize on the surface of the cloth, avoiding the consumption of so much heat and time, as well as injury to the fabric itself—with the advantage of being able to spread each coat successively, the solvent evaporating as when used with rubber, while it passes through the machine, the length not being limited to twelve yards, and there remains only to apply a coat of varnish to increase the brightness of the surface. Thus in one day can be done, not only the work of seven, but a greater quantity by working increased lengths. For oil-dressed cart sheets, omnibus and other driving aprons, waterproof packing materials, and a host of other such purposes, this preparation is most suitable. And lastly, we have the important use as a varnish, either as such or to mix with pigment, as a paint. We all know the time requisite for ordinary paint to dry—this we equally well know is the time requisite to dry or rather oxidize the oil in the paint. The spirit, be it turpentine or other solvent, would quickly evaporate. The coats of paint on doors and walls are but coats of oxidized oil, charged with pigment, as perfect and pliable skin as the coating of a fabric, if too much pigment has not been used. If then you complete the oxidation previously, and dissolve the oxidized oil so as to render it fit for application by the spreading machine of the manufacturer, or the paint-brush of the painter, when the solvent evaporates, which it does very rapidly, you have a flexible, tough, waterproof coating, which will be dry enough for succeeding coats within half-an-hour.

In carriage painting, floor cloth manufacture, and kindred articles, months are now consumed, which might well be saved. The patterns of felt on the table are printed with colours thus prepared, and some pieces of wood, painted at the carriage factory of Messrs. Holmes, are also here.

I am conscious how imperfectly my task has this evening been accomplished, but I have shown you how analogous a substance this material is to the elastic gums. In conclusion, I beg to thank you for the kind attention you have given me, and must apologise for the many defects and deficiencies which exist in this paper. Many of them would, I flatter myself, have been obviated but for the disastrous fire which occurred at our works the week before last, at which time I was engaged in preparing these particulars, and this has prevented my carefully reviewing the sheets before submitting their contents to you. Such a fatality will, I am sure, be an adequate excuse, and this must also be given as a reason why so poor a display of samples is placed for your inspection, our stock having been entirely destroyed. And I would add that, not being waterproofers ourselves, the samples are more roughly finished than would be the case if produced by more experienced hands.

We hope to have our works in order in about a month, and then we shall be most happy to demonstrate to any one interested, the applicability of this new material to the purposes specified.

DISCUSSION.

The Chairman in rising to invite discussion upon the valuable paper they had just heard, would offer one or two remarks. Most people who had ever worked in fatty chemistry, had no doubt, at some point of their researches, come upon either an elastic or a semi-elastic body, which tempted them to try to make what Mr. Walton had shewn them he had succeeded in making, viz.—an artificial substitute for india-rubber or gutta-percha. When he received the invitation to take the chair that evening, accompanied by a notice of the subject of the paper, he looked up some old specimens of the results of some elaborate experiments which he made (with an entirely different object) in 1855, on the distillation of castor oil, the residuum of which yielded an elastic material, analogous to that produced by Mr. Walton. He had brought those specimens with him, not on account of their value, but because they might be a means of suggesting some idea to gentlemen present acquainted with this subject, and also because the circumstance was an illustration of the working of the new patent laws. This was a case in which, having a promising invention, the first steps for a patent were taken, and then, finding there were difficulties in the way of working it out commercially, the patent was allowed to drop; but under the old law the patent would have been an obstruction to this invention, which was not the case under the new law.

Mr. P. L. Simmonds said, a few years ago, when on a visit to Mr. Walton, at Haughton Dale, he had the pleasure of going over the important manufactory which had been but incidentally alluded to in the paper. The works were specially devoted to the manufacture of those wire cards, or dents fixed in elastic bands, of which specimens were before them. Formerly a production of nature, the teazel, had been alone employed for carding wool and other fibrous substances, and raising the nap on cloth, but Mr. Walton, sen., had largely introduced the wire staples, or teeth, which had come so extensively into use. The simplicity and perfection of the machinery employed to accomplish the object were most remarkable, and these works might certainly be considered a marvel of industrial ingenuity and of the application of scientific skill to a particular and complicated purpose. At that time, when he was visiting him, Mr. Fred. Walton was pursuing, with great assiduity and perseverance, his scientific discoveries—in endeavouring to find substitutes for elastic gums, for papier maché materials, for ivory, &c. He had then solicited Mr. Walton to favour the Society with an account of the beautiful machinery of their works, and of his discoveries, and he was glad to find that he had not lost sight of the suggestion. The importance of the subject which had just been brought under their notice must be evident to all who gave it a moment's consideration. The application of elastic gums, as Mr. Walton had shown, was already widely extended, and their further extension was only stayed by high prices and

deficient supplies. Taking the latest year for which the official accounts were published (1860), the value of the raw india-rubber, and manufactures therefrom, amounted to £545,470, while that of gutta-percha was £161,170. Various quarters were being ransacked for new supplies of these gums, but there were difficulties in the way, in the shape of wild forests; difficulties of collection and transport, which would always tend to keep up the price of these substances, which also diminished as civilization progressed, for no planting of the trees was attempted. The uses, on the contrary, were becoming day by day more multiplied. If, therefore, any substitute, such as that proposed by Mr. Walton, could be brought into successful use, even for some of the minor and less important of the purposes of india-rubber, it would be a great advantage to the public and to the introducers. Moreover, as the material was so suitable and so abundant, it would largely promote the cultivation of the oil seeds in India and other countries, and a new use would be found for some of the vegetable drying oils which were now likely to be superseded for some purposes by the mineral or earth oils. Incidental mention had been made of the American imitation leathers; now he thought it possible that we might get a useful hint or two from the Japanese, who had admirably imitated the ordinary American leather cloths, and with a better face and substance; their mode of waterproofing these, and the oils and varnishes used, were worth careful consideration. A valuable collection, sent home by our Minister there, Mr. Alcock, might perhaps afford opportunities for examination. He noticed present many gentlemen largely interested in the elastic gum manufactures, and he hoped they would favour the meeting with their remarks upon the paper read and any cognate topics, as the subject was one in which the Society had always taken a deep interest.

Mr. Richard Beard, jun., said perhaps he should not be out of order in stating that it was the desire of the firm with which he was connected to have the opinions of those who were interested in the manufacture of india-rubber upon this new substance. They were not themselves engaged in the actual water-proofing, but they wished to bring the material before the attention of those who were engaged in that branch of business, in order that they might test its properties.

Mr. Birley (of the firm of Macintosh and Co.), wished to know whether this new oxidised oil was intended to take the place of india-rubber in all its present various applications, or only in certain cases? He apprehended that whilst it might be applicable to the waterproofing of cloth and other substances, it would hardly be a fit material for elastic bands, or valves for pumps, or for railway buffers. The use of oil as a waterproofing material had long been known, but he had no reason to doubt that this oxidised oil was a great improvement upon the old boiled linseed oil with which they were familiar. He should hardly suppose, however, without very strong proofs, that it was so thoroughly impervious to air and water as india-rubber, and there were many peculiarities in the chemical nature of india-rubber which he thought this new material did not possess. He should be glad to have some information on those points.

Mr. Glass wished to inquire whether he had rightly understood Mr. Walton to state that the only method of obtaining this oxidised oil was by spreading it thinly upon a surface, and then scraping it off and collecting it layer after layer, and afterwards dissolving it in naphtha, or methylated spirit. If so, he thought this was rather a slow process, and might be improved upon. With regard to the oxidation of oil, it had been suggested that the oxidation would not cease to go on after this substance was prepared, but would still advance rapidly, and this would be likely to make the material crack through its increasing hardness. That was especially the case with gutta-percha, and was a serious objection to its employment for the coating of wires. A slow oxidation went on, and it became brittle. They knew it to be the case with tarpaulins and similar materials, that the oxidising continued after the manufacture was completed; the action of the air did not cease after the substance had been partly oxidised. He had no doubt if the process of preparation described by Mr. Walton was the only one arrived at, it could be easily improved upon by bringing the oil to a certain temperature, and passing oxygen gas or atmospheric air into it, by which means he thought the material might be obtained in large quantities. He merely threw that out as a suggestion.

Mr. Beard, in reply to the question put by Mr. Birley, said it was for the manufacturers themselves to decide how far this material was to take the place of india-rubber in its various applications. He did not at present say that it was a substitute for india-rubber in all cases, but that it was applicable in a great many instances. The next point was that the coating with oil for waterproofing was a thing well known; he quite admitted that to be the case, but the treatment of the oxidised oil with solvents was what was claimed as new. The old process of waterproofing cloth by means of oils occupied some days, it being necessary to lay on several thicknesses, but by the new plan this waste of time was avoided. He now passed to the inquiries made by Mr. Glass, first as to the obtaining of this material by oxidising the oil in thin layers. The method at present employed had been described by Mr. Walton, who had discovered a mode of treating it so that it could be used in the same way as india-rubber. This material was not like oil, which had to be dried in the steam chest, but it would dry in the space of seven or eight yards, as the manufacture proceeded. With regard to the method of dissolving the material, he might state that that was a subject of investigation for many months, as it was difficult to find a solvent that would touch it; but this had now been obtained. With respect to the process of oxidation continuing after the manufacture of the material had been completed, he would state that if the oil was completely oxidized they had a perfectly stable substance, and the oxidation could be carried no further. He had samples which had been in existence two years, and in any temperature they remained as flexible as when they were first made.

Mr. Varley said that, many years ago, he had tried experiments with India-rubber, and found it to be readily soluble in turpentine, when it was reduced into a state suitable for manufacture. He was acting upon a committee of the Society at the time Dr. Montgomerie sent the first specimen of gutta-percha to this country. He believed a great portion of the gutta-percha now employed was of so deteriorated a quality that it would not last long for any purpose. It was very different in colour and quality to the genuine specimen which was originally forwarded to the Society by Dr. Montgomerie.

Dr. Riddell said some years ago he discovered a substance analogous to gutta-percha in the *Asclepias gigantea*, for when tested it was found to possess qualities similar to gutta-percha, and an experiment was made as to its insulating properties with a mile of telegraph-wire with perfect success. Since that time he had had a specimen of a similar substitute sent to him, the produce of an inspisated gum, from the *Sapota Mülleri* of British Guiana. He had taken the trouble that morning to dissolve some of it, and had brought it with him in the form in which it now was, and it was his anxious desire that some person interested in this subject should test its qualities, as nothing had as yet been done with it. It was a gum extracted from the tree by an operation precisely similar to that employed to obtain gutta-percha. There were many varieties of the *Ficus* which yielded substances analogous to caoutchouc, some of which were principally used by the natives of India as bird-lime. With regard to gutta percha, he believed it possessed resinous properties to a considerable extent, which he thought tended to impart the brittleness which had been spoken of. He had kept specimens for many years, and found them changed to a substance more like resin than gutta percha. Another specimen of gum,

the juice of a *Euphorbia*, was used by the natives for fastening handles to their hatchets and knives, and called by them in Madras catamundoo. It possessed great adhesive properties when softened by heat. A considerable quantity of that substance had been sent from Madras, but he had never heard of any use having been made of it here, and he should be glad to have its properties tested by some one acquainted with the subject.

Mr. Walter Hancock said he had devoted himself to the manufacture of gutta percha ever since its introduction into this country, and he should be happy to try experiments upon the material which Dr. Riddell had brought forward. He had been much struck with the paper of Mr. Walton, and he had no doubt the material to which he had drawn their attention would be applicable to many of the minor purposes for which india-rubber was at present employed; and if that were so, it would be a matter of great importance, because it was clear to all who were connected with that manufacture that the supplies of both india rubber and gutta percha had fallen off very considerably as compared with the constantly increasing demand for them in this country. As to the doubts that existed with regard to gutta percha, he thought they had arisen in many instances from a forgetfulness of what the material really was. It was purely a vegetable substance, and was therefore liable to many changes. In the treatment of it they must regard it in its highest state of organisation as a gum, and in its lowest state of organisation as possessing resinous properties, which accounted for its excessive brittleness in some cases. The gutta percha was imported into this country in the form of large blocks, and in these a great variety of quality might be detected. There was a great difference in the structural formation of the material, in its density, in its tensile strength, and, so to speak, in its longevity. Some of the earliest specimens sent to this country were as perfect in their peculiar properties as on the day they were received, sixteen years ago; but in other cases there were evidences of rapid decay in twelve months. There were many causes which accounted for the inferior quality of some of the gutta-percha. It might be taken from a tree nearly exhausted by age or blight, or the trees might be tapped at an improper season of the year, when the juices were weak and watery. There was also another circumstance; the gutta-percha was collected under the fierce rays of a tropical sun, which had a great effect upon the gum in depriving it of its proper density. He had great doubts whether this new material could ever be employed for the operations of telegraphy, like India-rubber and gutta-percha, which, with their great insulating power and inductive capacity, possessed that strength and toughness which formed material elements in the construction of ordinary telegraph cables. The frequent operations of coiling and uncoiling would be very prejudicial to any material which did not possess excessive toughness and strength.

Mr. P. L. Simmonds remarked that he believed a specimen of the gum introduced that evening by Dr. Riddell had been brought under notice by Sir Wm. Holmes, and was shown in the Paris Exhibition in 1855, but he did not think much had been done with it.

Mr. Beard said he had been requested to state the price at which the oxidised oil solution could be supplied. It was from 7d. to 8d. per lb., suitable for double cloth, whilst good india-rubber solution would be, he believed, from 1s. 4d. to 1s. 8d.

Mr. Hancock wished to add that he believed the specimen of gutta-percha forwarded to the Society was not the first introduction of that material into this country.* The sample which was experimented upon by his father was received from Mr. Gouger, in 1843. He believed if the material had not fallen into the hands of enterprising manufacturers, the present great results would not have been realised.

The Chairman said it was now his duty to request the meeting to pass the usual vote of thanks to Mr. Walton for his very able paper. He might state, with reference to one question asked by Mr. Glass as to the probability of continued oxidation taking place, that the material he alluded to before the discussion took place was exactly in the same state now as when he produced it in 1855; it had undergone no change whatever since then. It had arrived at the same point as Mr. Walton's oxidised oil, and the oxidation had not continued. He thought in this paper of Mr. Walton's they might congratulate themselves upon having a valuable addition to their transactions; and there was a minor point on which they might also congratulate themselves, that was, in the fact that they had that evening arrived at unanimity in the pronunciation of the word "gutta percha," inasmuch as in former discussions one speaker would call it "gutta perka" and another "gutta percha." Not long ago the point was submitted to a distinguished botanist, who was asked to decide what the proper pronunciation was. The reply was, in summer the substance was warm and soft, and then they might call it "gutta-percha;" in winter it was cold and hard, and then they should call it "gutta-perka." He (the Chairman) was happy to find that the temperature of the room that evening had brought them all to say "gutta-percha."

A vote of thanks was then passed to Mr. Walton.

The paper was illustrated by a collection of specimens of the material referred to in the latter part of the paper (oxidised oil), both in its raw and manufactured state. Samples of imitation leather, floor-cloth, kamptulicon, and various kinds of waterproof cloths prepared with it, were on the table, as well as some wooden panels covered with paints prepared with the patent oil, the latter kindly lent by Mr. H. M. Holmes, of Derby.

The Secretary announced that on Wednesday evening next, the 9th inst., a Paper by Mr. J. Gregory Crace, "On the Decoration of the International Exhibition Building," would be read.

* See *Journal*, Vol. VII. p. 20.

MEETINGS FOR THE ENSUING WEEK.

Mon.....Geologists' Association, 7. Mr. E. Cresy, "On Sculls and Flint Implements found in the Essex Marshes, during the Progress of the Main Drainage Works."
Entomological, 7.
Medical, 8½. M. de Méric, "On Syphilitic Metritis."
Royal Inst., 2. General Monthly Meeting.
Royal United Service Inst., 8½. Capt. W. R. Mends, R.N., "The Disembarkation of Troops."

Tues. ...Medical and Chirurgical, 8½.
Civil Engineers, 8. Discussion upon the Papers by Mr. Brunlees and Capt. Galton, on "Railway Accidents."
Zoological, 9.
Syro-Egyptian, Anniversary Meeting, 7. Mr. Samuel Sharpe, "On Egyptian Mythology," 7½.
Royal Inst., 3. Mr. John Marshall, "On the Physiology of the Senses."
Architectural Museum, South Kensington, 8. The Rev. Lord Alwyne Compton, "On Encaustic Tiles and Tile Pavements."

Wed. ...Society of Arts, 8. Mr. J. Gregory Crace, "On the Decoration of the International Exhibition Building."
Graphic, 8.
Literary Fund, 3.
Royal Soc. of Literature, 8½.
Archæological Assoc., 4. Annual Meeting.

Thurs...Royal, 8½.
Antiquaries, 8½.
Philological, 8.
Royal Society Club, 6.
Royal Inst., 3. Professor Tyndall, "On Heat."

Fri. .....Astronomical, 8.
Royal Inst., 8. Dr. Hofmann, F.R.S., "On Mauve and Magenta, and the Colouring Matters derived from Coal."
Royal United Service Inst., 3.

Sat.....Asiatic, 3.
Royal Botanic, 3¾.
Royal Inst., 3. Professor H. E. Roscoe, "On Spectrum Analysis."

PATENT LAW AMENDMENT ACT.

APPLICATIONS FOR PATENTS AND PROTECTION ALLOWED.

[*From Gazette, March 28th*, 1862.]

Dated 18th November, 1861.

2893. P. André, J. F. Pline-Faurie, and J. P. Richard, Bordeaux—Imp. in machinery or apparatus for preparing or manufacturing fuel.

Dated 17th December, 1861.

3165. J. Platt and W. Richardson, Oldham—Imp. in machinery or apparatus commonly called "gins" for cleaning cotton from seeds.

Dated 4th January, 1862.

35. H. D. Pochin, Salford—Imp. in the manufacture of rosin, soap, or size.

Dated 13th January, 1862.

93. W. E. Gedge, 11, Wellington-street, Strand—Improved means or apparatus for gaining or acquiring motive power. (A com.)

Dated 20th January, 1862.

145. A. Lamb, Southampton, and J. White, West Cowes—Imp. in life boats.

Dated 29th January, 1862.

235. W. Clark, 53, Chancery-lane—Imp. in the disintegration and bleaching of textile materials for the manufacture of paper. (A com.)

Dated 31st January, 1862.

257. H. Schatten, Hesse Cassel—Imp. in the manufacture or construction of gas meters.

Dated 1st February, 1862.

279. W. Clark, 53, Chancery-lane—Imp. in machinery or apparatus for the manufacture of festooned edging or material. (A com.)

Dated 4th February, 1862.

289. T. M. Meekins, 44, Chancery-lane—The production of a projectile and explosive force to be used in instruments of war, for an electric-gas gun and electric-gas shell, for the method of using the recoil of weapons for the purpose of increasing the pressure of elastic fluids, for the production of a projectile force, for a method of rapidly loading weapons at the breech, and of a motive force to be used in an electric-gas engine or other engines.

Dated 7th February, 1862.

323. J. Lloyd, Donnington, Shropshire—Imp. in buffers for engines and carriages on railways.

Dated 10th February, 1862.

347. W. Clark, 53, Chancery-lane—Imp. in reflectors. (A com.)

349. W. Clark, 53, Chancery-lane—Imp. in refining cast-iron, wrought, and other malleable iron, and in the cementation of iron. (A com.)

Dated 13th February, 1862.

389. G. C. Burrows, Stoke Holy Cross, Norfolk—Imp. in lounges, seats, or other apparatus for sitting or reclining on, which improvements are also applicable to rocking horses.

Dated 19th February, 1862.

435. C. T. Marzetti and J. Watson, Vine-street, Minories—Imp. in machinery or apparatus for raising, lowering, or otherwise moving or disposing casks and other bodies.

Dated 21st February, 1862.

459. J. Spence, Liverpool—Improved apparatus for transhipping and discharging grain and other substances, and for weighing, screening, and fanning such grain and substances during such transhipment and discharge. (Partly a com.)

467. W. McAdam and W. Chrystal, Glasgow—Imp. in sheaves or pulleys, journals, bushes, and other similar bearing or rubbing surfaces.

Dated 22nd February, 1862.

469. H. Chavasse, T. Morris, and G. B. Haines, Birmingham—An imp. or imps. in the manufacture and ornamentation of metallic bedsteads, part of which is also applicable to other articles.

471. W. H. Ross, Liverpool—Imp. in the manufacture of sugar. (A com.)

Dated 24th February, 1862.

489. R. Waller, Baker-street, Portman-square—Imp. in machinery and apparatus for joining leather and flexible and textile materials, and for the manufacture of boots and shoes, and other coverings for the feet.

Dated 25th February, 1862.

499. J. Carnaby, 7A, Skinner-street—Imp in turning, managing, and regulating the taps and valves of gas pipes.

Dated 26th February, 1862.

516. A. Green, Rose-cottage, North-road, Forest-hill, Lewisham—Imp. in the method of, and apparatus for, bordering paper, envelopes, and cards with black or coloured borders.

519. G. Rees, Goswell-road—Imp. in the construction of marine sub-ways.

Dated 28th February, 1862.

551. R. A. Brooman, 166, Fleet-street—Imp. in the manufacture of hats and bonnets. (A com.)

Dated 1st March, 1862.

555. J. Sim, Aberdeen—Imp. in the construction of gas meters.

556. H. C. Muller, Russell-place, New North-road—Imp. in the manufacture of imitation bear skin caps.

559. P. J. Guyet, Paris—Imp. in taps or valves.

Dated 3rd March, 1862.

578. T. Tillam, Church-street, Deptford-green — An improved method of purifying gas.

Dated 4th March, 1862.

585. J. Gjers, Middlesborough, Yorkshire—A material or sand for the formation of moulds for casting iron and for other like purposes.

586. J. Ellis, Petersham—Imp. in hooks and swivels for fastening chains of all sizes and for other similar purposes.

592. G. H. Cottam and H. R. Cottam, St. Pancras Iron Works, Old St. Pancras Road—Imp. in horticultural buildings and other glazed structures.

Dated 5th March, 1862.

595. J. Sidebottom, Harewood, near Mottram, Cheshire—Imp. in fire-arms and ordnance and in projectiles.

597. J. Somerville and R. M. Somerville, Netherfield, Westmoreland, and M. Blanc, Birmingham—Certain imp. in the manufacture of boots and shoes.

599. J. Chubb, St. Paul's Church-yard, and H. M. Burton, John's-place, Holland-street, Southwark—Imp. in apparatus for displaying or exhibiting jewellery and other valuable articles in glass cases.

601. E. Partington, Heap-bridge, Lancashire—Certain imp. in the method of cleansing and preparing rags or other materials used in the manufacture of paper and in machinery or apparatus connected therewith.

603. W. E. Newton, 66, Chancery-lane—An improved process and apparatus for reducing wood, straw, and other vegetable substances to pulp for the manufacture of paper. (A com.)

Dated 7th March, 1862.

607. J. G. Shipley, 181, Regent-street—Imp. in bridle-heads, reins, and bits.

609. T. Farrimond, Manchester—An improved safety cage for mines.

613. T. Ball, W. Ball, and J. Wilkins, Broadway, Nottingham—Imp. in the manufacture of warp fabrics in warp machines.

616. R. Restall, Croydon, Surrey—Imp. in apparatus for connecting and disconnecting carriages and engines on railways, as also signal lines between guard and driver.

617. T. H. Wood, Blackweir, Glamorganshire—Imp. in apparatus employed in the manufacture of artificial fuel.

Dated 8th March, 1862.

621. G. Edmondson, Queenwood, Southampton—Imp. in washing machines.

623. W. Paterson, W. A. Sanderson, and R. Sanderson, jun., Gala Mills, Galashields, N.B.—Imp. in finishing woven fabrics.

627. W. N. Wilkins, Saint John's-wood—Imp. in the manufrcture of pigments for oil and water colours.

629. S. Grice, Birmingham—An imp. or imps. in propellors for propelling ships and boats and other vessels.

631. W. Palmer, Bell House, Southweald, Essex—Imp. in the manufacture of candles.

633. F. N. Gisborne, 3, Adelaide-place, London-bridge, and H. Wickens, 4, Tokenhouse-yard, Bank—Imp. in the means of indicating the presence of fire damp or choke damp in mines, and of dispersing fire damp, and also of telegraphing in mines.

635. F. R. Newton and H. Codd, Esher-street, Westminster—An apparatus for indicating and measuring the flow of liquids.

Dated 10th March, 1862.

637. M. A. F. Mennons, 39, Rue de l'Echiquier, Paris—Imp. in breech-loading firearms. (A com.)

641. W. Parker and G. H. Batman, Copmanthorp, Yorkshire—Imp. in steam engines.

643. W. J. Bennett, 21A, Millbank-street, Westminster—An improved solution or preparation to be used with Portland and other cements for the production of artificial stone, or for building purposes.

645. W. S. Nosworthy, 79, Coleman-street—Imp. in upright and horizontal pianofortes.

647. J. B. G. M. F. Piret, 29, Boulevart St. Martin, Paris—Imp. in lubricating apparatus.

649. M. Henry, 84, Fleet-street—An imp. in preparing hooks and hooks and eyes for sale or consumption. (A com.)

Dated 11th March, 1862.

651. R. Peacock, Manchester—Imp. in the manufacture of window blinds.

653. E. Parfitt, Drury-lane—A watch protector.

655. E. Humphreys, Deptford—Imp. in steam engines.

657. E. G. Camp, Bristol—Imp. in brushes or apparatus for brushing.

660. H. Baynes, Clements-lane—An imp. in bankers' cheque books.

661. R. Smith, Glasgow—Imp. in telegraph posts.

663. W. Clark, 53, Chancery-lane—Imp. in apparatus for effecting submarine operations. (A com.)

Dated 12th March, 1862.

664. A. R. Le Mire de Normandy, Odin-lodge, King's-road, Clapham-park—An improved method of connecting gas and other pipes.
667. W. H. Latham and F. C. W. Latham, Bolton—Certain imp. in machinery or apparatus for perforating and numbering paper or other substances to be employed as "tickets" or where other "counter registration" is required.
669. A. Watson, Glasgow—Imp. in hot-pressing apparatus.
671. W. Conyers, Leeds Bridge, Leeds—Imp. in currying leather.
675. W. Clark, 53, Chancery-lane—Imp. in the manufacture of coloured inks. (A com.)
677. J. E. Grisdale, 73, Oxford-street—Imp. in photographic cameras, and in the mode of fixing the lens therein.
679. W. E. Newton, 66, Chancery-lane—Imp. in the manufacture of cartridges. (A com.)

Dated 13th March, 1861.

688. J. Howard and J. Bullough, Accrington, Lancashire—Imp. in warping and beaming machines.
692. R. A. Brooman, 166, Fleet-street—Imp. in apparatuses for measuring and regulating the flow and pressure of gas, parts of which are applicable to hydraulic receivers and to steam generators. (A com.)
700. J. Kent, Hyson-green, Nottingham—Imps. in cleansing and bleaching. (Partly a com.)

Dated 14th March, 1862.

706. L. Gabler, 41, Bernard-street, and M. Zingler, 14, Granville-street—Imp. in manufacturing articles from ivory and bone.
708. A. J. Paterson, Edinburgh—Imp. in the construction of electric telegraph cables.

Dated 15th March, 1862.

712. W. Clark, 53, Chancery-lane—An improved brake for railroad carriages. (A com.)
720. Capt. H. Y. D. Scott, R.E., Brompton Barracks, near Chatham—Imp. in the manufactre of cement.
722. J. Avery, 26, Mark-lane—Imp. in purifying coal. (A com.)
724. J. Robey, 49, Hereford-road North—Imp. in manufacturing and refining sugar, and in apparatus employed therein.
726. J. T. Pendlebury and T. Pendlebury, Bury—An improved form of lubricator.

Dated 17th March, 1862.

730. W. B. Lord, Plymouth, and F. H. Gilbart, Brixton—Improved means or apparatus for raising, lowering, and releasing ships' boats or other heavy bodies.
732. W. Bowser, Glasgow—Imp. in ships' fire hearths, or boiling and cooking apparatus.
734. J. Weems and W. Weems, Johnstone, Renfrew, N.B.—Imp. in apparatus for indicating the pressure or quantity, and in regulating the discharge of fluids.
736. W. Barford, Peterborough—Imp. in rollers for rolling land.
738. G. T. Bousfield, Loughborough-park, Brixton—Imp. in cranks for driving sewing machines and other machinery. (A com.)
740. J. Hicks, Hatton-garden—Imp. in mercurial barometers.
744. T. Myers, Brighton—Imp. in meters for mesuring water, gas, or other fluids.

Dated 18th March, 1862.

748. M. A. F. Mennons, 39, Rue de l'Echiquier, Paris—An improved needle threading apparatus. (A com.)
752. W. Tongue, Bradford—Imp. in machinery and in processes for preparing, heckling, dressing, and combing flax, hemp, silk, and other fibrous materials.
756. J. A. Ronketti, 31, Northampton-road, Clerkenwell—Imp. in meteorological instruments and thermometers.
758. S. Slack, West-street, New Sneinton, Nottingham—Imp. in the manufacture of stockings and other fabrics in circular knitting machines.
760. R. A. Brooman, 166, Fleet-street—Imp. in the manufacture of barytes and barytic products, and the application of these substances in the manufacture of sugar and other uses. (A com.)

Dated 19th March, 1862.

762. A. Krupp, Essen, Rhenish Prussia—Certain imp. in the method of manufacturing shafts for steamboats and other purposes.
764. S. Desborough, Noble-street, St. Martin's-le-Grand—Imp. in the manufacture or construction of sewing or other needles.
766. S. Moore, Liverpool—Certain imp. in machinery for compressing and cutting tobacco.
768. R. A. Brooman, 166, Fleet-street—Imp. in reproducing or in producing copies of guipure, lace, embroidery, and other like articles. (A com.)
770. R. A. Brooman, 166, Fleet-street—Imp. in apparatuses for drawing in and paying out chain cables, applicable to windlasses and capstans. (A com.)

Dated 20th March, 1862.

776. R. M. Roberts, Kensington—Imp. in obtaining and applying motive power.

Invention with Complete Specification Filed.

818. M. A. F. Mennons, 39, Rue de l'Echiquier, Paris—Certain imp. in machinery for the production of ornamental stitching or embroidery. (A com.)—24th March, 1862.

Patents Sealed.

[*From Gazette, March 28th*, 1862.]

March 28th.

2281. J. B. Howell.
2431. T. Smith.
2455. J. Davies and T. Evans.
2456. W. Maltby.
2458. R. A. Brooman.
2459. W. Thompson & T. Stather.
2462. C. G. Hill.
2464. W. T. Henley.
2470. T. Evans.
2473. W. Malam.
2477. C. Husson.
2478. A. David.
2487. J. Lansley.
2494. G. Nares.
2538. W. Clark,
2578. W. Clark.
2625. F. A. Calvert.
2638. F. O. Ward.

[*From Gazette, April 1st*, 1862.]

April 1st.

2447. J. W. Scott.
2480. G. Knox.
2488. J. Edwards.
2490. W. Rowan.
2492. J. S. Collins.
2496. T. Hughes.
2502. G. K. Stothert.
2506. A. Ford.
2522. F. Curtis.
2523. W. Palmer.
2525. T. Tidmarsh.
2530. W. Mould, J. Hall, S. Cook. and W. H. Hacking.
2552. H. Nelson.
2604. J. H. Johnson.
2614. J. Bourne and E. Kidd.
2616. C. De Bergue.
2636. G. England.
2643. G. H. Birkbeck.
2720. E. Leigh.
2732. J. A. Fanshawe and J. A. Jaques.

Patents on which the Stamp Duty of £50 has been Paid.

[*From Gazette, March 28th*, 1862.]

March 24th.

765. M. Firth.
768. M. A. Muir & J. McIlwham.

March 25th.

781. J. W. Kelly.
786. I. Spight.

[*From Gazette, April 1st*, 1862.]

March 27th.

778. T. Carr.
787. T. Taylor.
798. C. P. Coles.
806. T. Ivory.
809. S. S. Bateson.
836. J. Eccles.

March 28th.

780. W. Mossman.

March 29th.

800. A. V. Newton.
851. L. Brierley and H. Gearing.

Patents on which the Stamp Duty of £100 has been Paid.

[*From Gazette, March 28th*, 1862.]

March 24th.

664. J. H. Johnson.
709. W. Tytherleigh.

March 26th.

663. J. McKinnell.

LIST OF DESIGNS FOR ARTICLES OF UTILITY REGISTERED.

No. in the Register.	Date of Registration.	Title.	Proprietor's Name.	Address.
4458	March 29.	Parts of Jewellery	Felix Mège	95, Wimpole-street, Cavendish-sq., W,
4459	,, 31.	Box Chest and Case Fittings...	Thos. Bianchi	Regent-place, Birmingham, and 16, Gresham-street, London, E.C.
4460	April 1.	Scarf, Finger, and other Ring	Hyman Hyman	Birmingham.
4461	,, ,,	Spring Bale Hook	William Partridge	Royal Artillery, Woolwich.